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## COMPLEX THINNING ADDITIONS FOR CERAMIC SLIPS

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The influence of the complex additions SB-FF + STPP, S-3 + STPP, reotan + STPP on ceramic slip mobility is examined. The action of these complexes on the physical – chemical properties of ceramic samples after kilning is studied. It is found that the complex addition SB-FF + STPP makes it possible to increase ceramic slip mobility and mass build-up rate as compared with the additions based on S-3 and reotan as well as to improve the operating properties of finished articles.

**Key words:** ceramic slip, complex thinning additions, mass build-up rate, properties of ceramic.

The physical – mechanical properties of ceramic articles obtained by casting technology using gypsum molds are directly related with the mobility and moisture content of the casting slip. One of the most effective methods of regulating the rheological properties and moisture content of slips is to use thinning additions. Quite many such additions based on individual substances and production wastes have now been developed. However, the demand for them is far from being met. So, the search for new effective thinning additions is topical.

It has been shown [1, 2] that the mobility of suspensions is observed to increase substantially when fluoroglucin furfural oligomers (SB-FF) are introduced into clayey suspensions in a complex with conventional thinners. The addition of SB-FF in a complex with sodium tripolyphosphate (STPP) is especially effective. The objective of the present work is to study the influence of the complex SP-FF + STPP on the mobility of ceramic slip and the physical – mechanical properties of finished articles.

A typical ceramic slip used to produce sanitary-technical articles was chosen for the present investigations. The contents of the slip are as follows (%<sup>2</sup>): 9 Vesko Granitik clay, 12 Vesko Keramik clay, 22 Glukhovetskoe kaolin, 22 Novikovskoe sand, 15 Vishnevogorskoe spar, 11 porcelain scrap, 3 Latenskoe clay, and 6 Prosyankovskoe kaolin.

The slip was prepared by wet grinding in a ball mill. The fineness of the milling was determined according to the residue 1.5 – 2% on a No. 0063 strainer. The volume content of the dispersed phase was 37% and the slip density was 1700 kg/m<sup>3</sup>. A complex addition SB-FF + STPP was intro-

duced with a mass ratio of the components 1 : 4, respectively, into the slip. The largest thinning effect is observed with this ratio. For comparison, we obtained and investigated similar complexes with known and widely used additions: S-3 + STPP and reotan + STPP. It was established that the same STPP content in the addition (about 75%) is optimal for these additions.

All complex additions were introduced in the suspension in the amount 0.1% in terms of the mass of the dry matter.

An Engler viscosimeter was used to evaluate the mobility of the ceramic slip according to the outflow time of 100 ml of slip after the slip has been allowed to rest for 30 sec  $t_1$  and 30 min  $t_2$ . In addition, the thickening constant was determined. The rate of mass build-up on the walls of the gypsum mold was determined by the standard technique. The results of these investigations are presented in Table 1.

It is evident that the introduction of the complex SB-FF + STPP makes it possible to increase substantially the mobility and mass build-up rate and to decrease the thickening constant of the slip as compared with the complex S-3 + STPP. The complex reotan + STPP, containing an imported component, gives a similar thinning effect, but in this case the mass build-up rate decreases, which is undesirable because the process time increases.

TABLE 1.

Addition	Flow, sec		Thickening constant	Mass build-up rate, g/(cm <sup>2</sup> · min)
	first $t_1$	second $t_2$		
SB-FF + STPP	12	14	1.2	0.092
S-3 + STPP	20	28	1.4	0.087
Reotan + STPP	13	15	1.2	0.080

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<sup>2</sup> Here and below unless otherwise stipulated — content by weight.

TABLE 2.

Indicator	Thinning addition		
	SB-FF + STPP	S-3 + STPP	reotan + STPP
Density:			
apparent, kg/m <sup>3</sup>	2130	2030	1980
relative, %	82.0	78.1	76.1
Porosity, %:			
open	1.5	2.1	2.2
closed	16.5	19.9	21.8
Water absorption, %	0.71	1.03	1.20
Compression strength, MPa	82	67	55

The influence of the complex addition on the physical – mechanical properties of the samples after kilning was studied.

The experimental cubic samples were cast in gypsum molds and dried for 6 h in a SMOL-250 desiccator. The highest drying temperature was 80°C. The samples were kilned in SMOL-130 furnaces with a silicon carbide heater in 22 h. The highest kilning temperature was 1200°C.

The influence of the additions on the technological characteristics of the samples after kilning is shown in Table 2.

Evidently, the introduction of the complex addition SB-FF + STPP into the ceramic slip increases the density of the finished articles by 5 – 8% as compared with samples containing the addition S-3 + STPP and reotan + STPP, respectively. The open porosity decreases by 40 – 47% and the closed porosity by 20 – 32%. The decrease of the porosity of the samples with the SB-FF + STPP addition results in 45 – 69% lower water absorption, and the porosity of the articles increases as a result of the increase of the density.

The decrease of the porosity of the kilned samples with the additions developed is supported by studies performed

with a NEOFHOT-32 stereoscopic microscope with  $\times 120$  magnification.

The samples containing SB-FF and STPP additions have a denser, uniform structure with fewer pores than samples containing the addition based on S-3 and reotan.

The complex addition SB-FF + STPP makes it possible to increase the density of the samples after casting in gypsum molds as compared with additions based on S-3 and reotan. This can be explained by the closer packing of the particles due to the peptizing effect and by an increase of the aggregate stability of the slip when this complex is introduced.

The denser uniform structure of the dried samples has a favorable effect on the sintering process, as a result of which a decrease of porosity and therefore water absorption also is observed in samples with the SB-FF + STPP addition. An increase of the density of a sample also results in higher strength under compression.

In summary, the addition of the complex SB-FF + STPP into ceramic slip makes it possible to increase the mobility of the slip and the mass build-up rate as well as to improve the operating properties of finished articles as compared with complexes containing the conventional thinners.

## REFERENCES

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